COHESIVE ELEMENTS FOR DYNAMIC FRACTURE ANALYSIS OF HOMOGENEOUS AND GRADED MATERIALS

Zhengyu (Peggy) Zhang and Glaucio H. Paulino

Department of Civil and Environmental Engineering,
University of Illinois at Urbana-Champaign,
Newmark Laboratory, 205 North Mathews Avenue, Urbana, IL 61801, U.S.A.

The detailed theory and implementation of a widely used Cohesive Zone Model (CZM) and a recently developed CZM for Functionally Graded Materials (FGMs) are presented in this benchmark problem paper. The problem under investigation involves dynamic crack propagation of an initially stretched elastic strip with pre-crack. The elastic strain energy stored within the system drives the crack to propagate, and this dynamic process is simulated using finite element analysis with the cohesive elements. The failure criterion is incorporated in the CZM using both a finite cohesive strength and work to fracture in the material description. The theoretical crack speed limit and the energy terms associated with various system responses are provided as verification for the numerical implementation. This benchmark problem can be used to validate explicit dynamic codes that investigate crack propagation using cohesive elements for both homogeneous and graded materials.